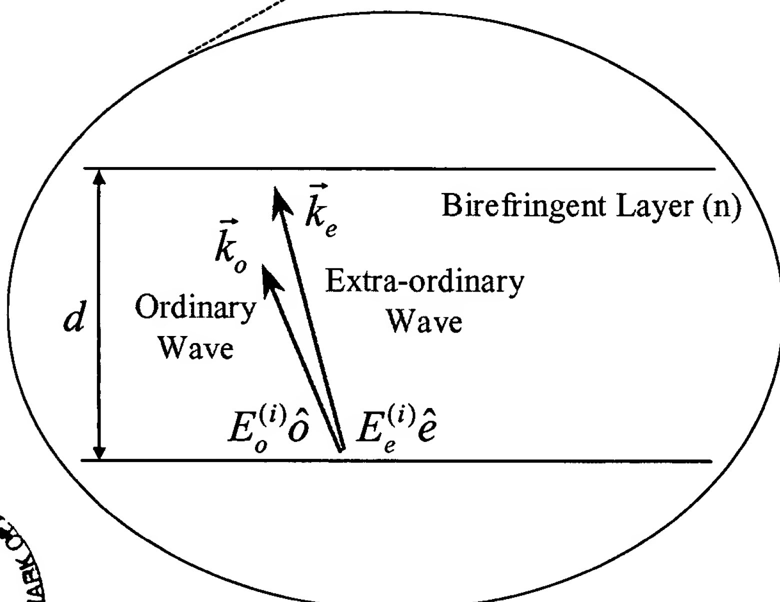
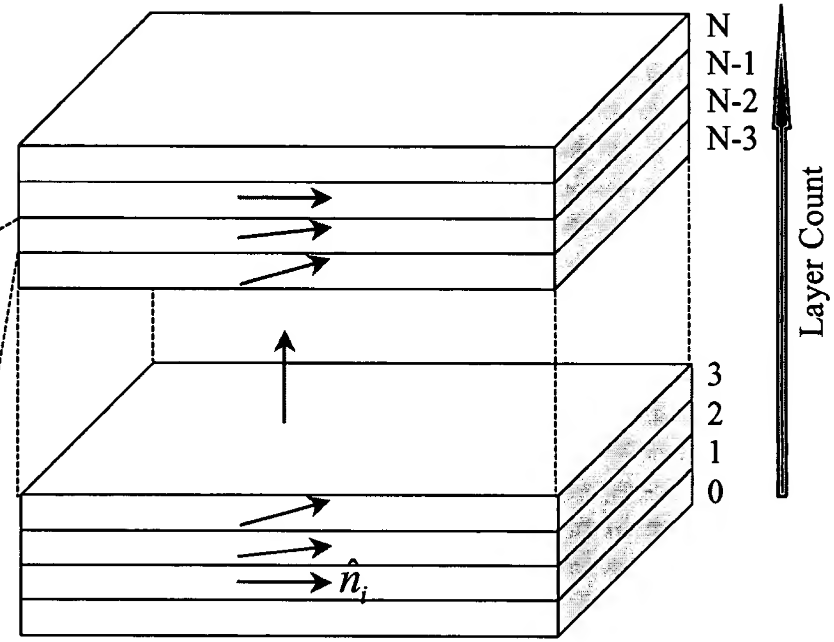
The Extended Jones Method

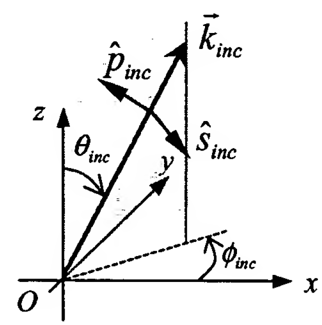
Addresses light wave propagation in a stratified medium, consisting of a stack of birefringent layers. In almost all practical situations the birefringence is small:

$$|n_e - n_o| << n_o, n_e$$

$$\hat{o} = \frac{\vec{k}_o \times \hat{n}}{|\vec{k}_o \times \hat{n}|} \quad \hat{e} = \frac{\hat{o} \times \vec{k}_o}{|\hat{o} \times \vec{k}_o|}$$







The basic idea is to trace the propagation of a plane wave through the stack monitoring the change in its state of polarisation (SOP).

The propagation though the stack can be thought as the product of various matrices:

$$\boxed{\mathbf{M} = \mathbf{D}_o \mathbf{P}_N \mathbf{D}_{N-1,N} \mathbf{P}_{N-1} \mathbf{D}_{N-2,N-1} \cdots \mathbf{D}_{1,2} \mathbf{P}_1 \mathbf{D}_{0,1} \mathbf{P}_0 \mathbf{D}_i}$$

$$\boxed{\begin{bmatrix} E_s^{out} \\ E_p^{out} \end{bmatrix} = [\mathbf{M}] \begin{bmatrix} E_s^{inc} \\ E_p^{inc} \end{bmatrix}}$$

Four type of matrices are needed:

<u>a) Input Dynamic Matrix</u> $\boxed{\mathbf{D}_i}$

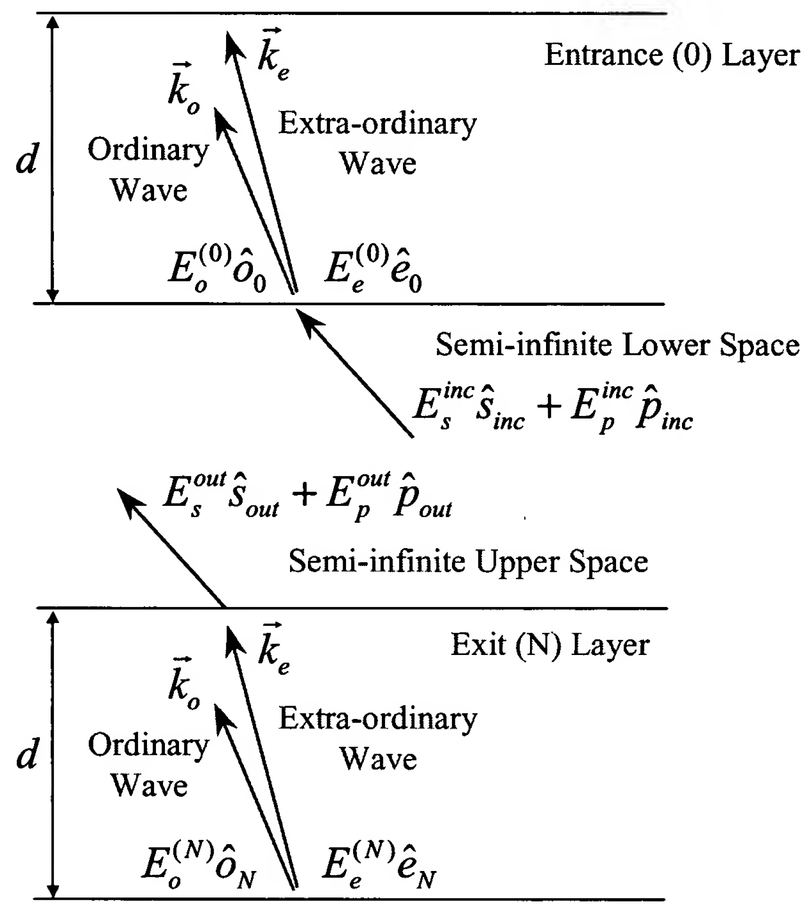
Semi-infinite space to entrance layer transition.

$$\boxed{\begin{bmatrix} E_e^{(0)} \\ E_o^{(0)} \end{bmatrix} = \begin{bmatrix} t_s \hat{s}_0 \cdot \hat{e}_0 & t_p \hat{p}_0 \cdot \hat{e}_0 \\ t_s \hat{s}_0 \cdot \hat{o}_0 & t_p \hat{p}_0 \cdot \hat{o}_0 \end{bmatrix} \begin{bmatrix} E_s^{inc} \\ E_p^{inc} \end{bmatrix}}$$

<u>b) Output Dynamic Matrix</u> $\boxed{\mathbf{D}_o}$

Last layer to semi-infinite space transition.

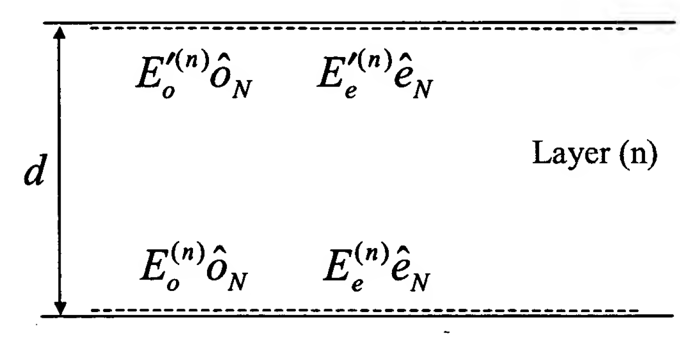
$$\boxed{\begin{bmatrix} E_s^{out} \\ E_p^{out} \end{bmatrix} = \begin{bmatrix} t_s' \hat{e}_N \cdot \hat{s}_N & t_s' \hat{o}_N \cdot \hat{s}_N \\ t_p' \hat{e}_N \cdot \hat{p}_N & t_p' \hat{o}_N \cdot \hat{p}_N \end{bmatrix} \begin{bmatrix} E_e^{(N)} \\ E_o^{(N)} \end{bmatrix}}$$



c) Propagation Matrix $\boxed{\mathbf{P}_i}$

Propagation inside the birefringent layer.

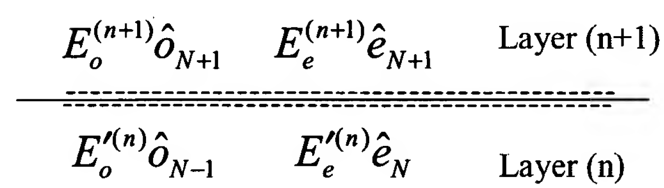
$$\boxed{\begin{bmatrix} E_e'^{(n)} \\ E_o'^{(n)} \end{bmatrix} = \begin{bmatrix} e^{-jk_{e,z}d} & 0 \\ 0 & e^{-jk_{o,z}d} \end{bmatrix} \begin{bmatrix} E_e^{(n)} \\ E_o^{(n)} \end{bmatrix}}$$



d) Dynamic Matrix $\boxed{\mathbf{D}_{n,n+1}}$

Transition from layer (n) to layer (n+1)

$$\boxed{\begin{bmatrix} E_e^{(n+1)} \\ E_o^{(n+1)} \end{bmatrix} = \begin{bmatrix} \hat{e}_n \cdot \hat{e}_{n+1} & \hat{o}_n \cdot \hat{e}_{n+1} \\ \hat{e}_n \cdot \hat{o}_{n+1} & \hat{o}_n \cdot \hat{o}_{n+1} \end{bmatrix} \begin{bmatrix} E_e'^{(n)} \\ E_o'^{(n)} \end{bmatrix}}$$



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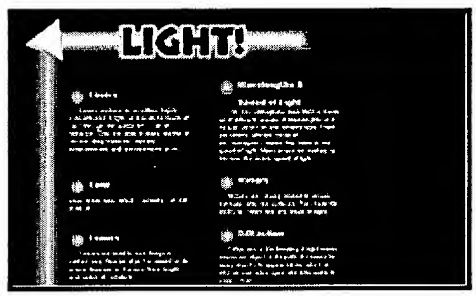

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Site Desciption

Light! is a reference website devoted to the physics of light. Topics include the speed of light, wavelengths, mirrors, lenses, diffraction, lasers, refractions, reflections, solar power, and a history on the study of light. Each section is complete with a quiz that can be used to test one's knowledge or to review abilities. Light! is written in both English and Polish. The educational objectives of Light! is to serve as a research guide and self-teacher to students interested in light.

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Refraction

Refraction is the change in direction of a wave when it passes into a new substance. The reason the light changes direction or "bends" is because each different substance has it's own effect on the speed of light within itself. Every substance has an optical density, this number, called the substance's index of refraction, is how well light passes through it, the higher the density, the harder time light has moving through it. This number can be determined in two ways, first, the index can be found by taking the ratio of the speed of light in a vacuum (3x106 km/s) and the speed of light in the substance. It can also be found by taking the ratio of the sine of the angle of incidence and the angle of refraction, similar to the angles mentioned above. This equation is called Snell's Law. Where the light hits the new substance, the perpendicular to that spot is referred to as the normal, regaurdless of what angle the light hits at. If the new substance has a higher index of refraction than the substance the light was in, the ray of light will be bent towards the normal. Conversely, if the new subtance is of a lower optical density, the light will bend away from the normal.